Branch of Research - Forest Service

U. S. Department of Agriculture

CENTRAL STATES FOREST EXPERIMENT STATION
208-209 Horticulture and Forestry Building
Ohio State University
Columbus, Ohio

ANNUAL INVESTIGATIVE REPORT FOR 1934

AND PROGRAM FOR 1935

(Calendar Years)

CENTRAL STATES REGION

Ohio
Indiana
Illinois
Iowa
Missouri
Western Kentucky
Western Tennessee
Northern Arkansas

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FOREWORD

The Central States Forest Experiment Station is one of eleven regional stations maintained by the Branch of Research of the Forest Service, U. S. Department of Agriculture. Created by act of Congress, the Station was established at Columbus in 1927, in cooperation with the Ohio State University and the Ohio Agricultural Experiment Station. Studies and investigations are conducted by the Station to obtain essential information concerning the forest problems of the central hardwood region. The territory served includes all or part of eight states: Ohio, Indiana, Illinois, Iowa, Missouri, western Kentucky, western Tennessee, and northern Arkansas. Representatives of various interests in this region constitute the membership of the Central States Forest Research Council, which acts in an advisory capacity to the Station, and as a coordinating agency for forest research.

STATION STAFF - 1934

FOREST SERVICE PERSONNEL

Willis M. Baker	Director
John T. Auten	Silviculturist
Leonard F. Kellogg	Associate Silviculturist
Ralph K. Day	Associate Silviculturist (a)
John G. Kuenzel	Assistant Silviculturist (b)
Boyd B. Parker	Senior Clerk
Charlotte Huston	Clerk-Stenographer

Emergency and Temporary Personnel

Arthur G. Chapman	Associate Conservationist
E. G. Wiesehuegel .... (June - September)	Associate Conservationist
Claud E. Sutton	Technician (J. F.)
Oliver D. Diller	Technician (J. R. E.)
Clyde R. Cochran	Assistant to Technician
F. S. Van Sickle .....(June - September)	Assistant to Technician
E. D. Marshall.....(June - August)	Assistant to Technician
Ben F. Myer	Office Assistant
Dell Day ..... (Part time)	Librarian
Doris Dobbins .....(May - November).....	Stenographer
Mary Buzzard	Stenographer
Ruth Allen	Stenographer
E. R. Green	Caretaker, Sylamore Branch

Temporary Personnel for Construction Work

H. M. Black	Sylamore Branch Station
Earnest Bantel	Illinois Branch Station
William Wilson	Illinois Branch Station

BUREAU OF ENTOMOLOGY

Ralph C. Hall	Assistant Entomologist
B. H. Wilford ..... (January - August)	E.C.W. Entomologist
Herbert C. Secrest	Field Assistant
Charles R. Page	Field Assistant
H. A. Waters ..... (May - September)	Field Assistant
L. O. Edwards ..... (June - September)	Field Assistant

(a) Promotion from Assistant Silviculturist, September, 1934.

(b) Promotion from Junior Forester, January, 1935.

CENTRAL STATES FOREST RESEARCH COUNCIL

1935

Alexander Thomson, President., C. V. Anderson, Vice-Pres., W. M. Baker, Sec.

C. Vivian Anderson, Insurance, 1205 Union Trust Building, Cincinnati, Ohio.

C. H. Barnaby, Lumberman, Greencastle, Indiana.

R. M. Brown, President, Missouri Farm Bureau, Jefferson City, Missouri.

T. H. Frison, Chief, State Natural History Survey, Urbana, Illinois.

Chas. A. Gillett, State Forester, Little Rock, Arkansas.

J. O. Hazard, State Forester, Nashville, Tennessee.

Chas. E. Hearst, President, Iowa Farm Bureau, DesMoines, Iowa.

C. F. Huhlein, Bernheim Foundation, 615 Louisville Trust Co. Bldg., Louisville,Ky.

S. B. Locke, Conservation Director, Izaak Walton League, Chicago, Ill.

Geo. B. MacDonald, Professor of Forestry, Iowa State College, Ames, Iowa.

Lachlan Macleay, Exec. Vice-President, Mississippi Valley Asso., St. Louis, Mo.

A. F. Moon, President, Ohio Conservation Council, Columbus, Ohio.

E. E. Pershall, President, T. J. Moss Tie Co., St. Louis, Missouri.

Edmund Secrest, State Forester, Wooster, Ohio.

J. H. Skinner, Director, Purdue Agri. Exper. Station, Lafayette, Indiana.

Earl C. Smith, President, Illinois Agri. Asso., 608 Dearborn St., Chicago, Ill.

Alexander Thomson, President, Champion Coated Paper Co., Hamilton, Ohio.

E. N. Transeau, Professor of Botany, Ohio State University, Columbus, Ohio.

Tom L. Wheeler, Editor, Indiana Farmers Guide, Huntington, Indiana.

Ralph Wilcox, State Forester, Indianapolis, Indiana.

CENTRAL STATES FOREST EXPERIMENT STATION

ANNUAL INVESTIGATIVE REPORT FOR 1934

PROGRAM FOR 1935

Progress in 1934

During 1934 the Central States have witnessed for the first time region-wide progress toward the conservation of forests and the resources of timber, water, soil, and wild life which they produce or safeguard. Public projects of planned land utilization for the development and protection of natural wealth have been started by governmental agencies, not only to combat the depression and to relieve unemployment, but to bring about a balance of conditions which may tend to prevent a future reoccurrence of the present situation. As these projects become properly coordinated, with duplication of effort eliminated and authority delegated to efficient and responsible agencies, their development will inevitably exert a powerful influence in many ways on regional and national welfare.

The Station has shared in the responsibilities and obligations of various projects of this emergency conservation program, and in the progress that has been made. Members of the staff have participated in national, regional, and local conferences where plans have been developed, and have cooperated with various agencies in putting these plans into operation. In many instances timely and urgently needed information has been furnished. With the expenditure of funds allotted for unemployment relief, a total of 5,800 man days' labor has been provided on Station projects during this period.

Through the cooperation of the administrative branch of the U. S. Forest Service in Arkansas and Illinois, and the State Foresters of Ohio and Indiana, four experimental forest areas have been set aside permanently for the use of the Station, and branch station improvements have been made with emergency funds. The development of these and other permanent experimental areas will at last provide the Station with the means for intensive research so necessary to the progress of forestry in a region where there is an acknowledged lack of information essential to sound forestry practices. When facts are lacking, costly delays and mistakes become inevitable.

It is most unfortunate that a well-balanced and comprehensive program of forest research could not have preceded by several years the present expansion of forest land management in the Central States. The new National Forest units established in Missouri, Illinois, Kentucky, and proposed for Indiana and Ohio, create an urgent demand for more information upon which to base an accurate appraisal of the best methods of operation in many fields, or a prediction of results to be expected. The demand for facts is increased by the extensive and expanding operations of the Civilian Conservation Corps, and by the conservation projects of various other agencies now undertaking new work on a large scale for the first time in this region. It is unfortunate that this Station, handicapped by inadequate resources and by a multitude of administrative obligations, cannot immediately undertake the many investigations necessary to furnish the information now being called for. The immediate expansion of forest research in the Central States is highly imperative.

Experimental Areas and Branch Stations

Up to 1934 the Station's work has consisted largely of region-wide surveys of forest conditions, and of investigative projects, extensive rather than intensive in scope. This has been due in part to the usual requirements of preliminary work in a new region, and also to urgent demands for special information, such as that required for the Mississippi Flood Report of 1927-1928, the Extensive Revision of Forest Statistics of 1931, the comprehensive Copeland Report of 1932, and the 1934 compilation of data for land use planning. Now, with the recent creation of new National Forest units in the Central States, the Station has been given not only the opportunity, but also the obligation, to establish permanent experimental areas and branch stations where more intensive research may be undertaken over a period of years. Much of this work will have direct and immediate application to the management of the surrounding forest lands. With allotments of unemployment relief funds for construction, 1934 witnessed the establishment and improvement of several experimental areas.

Arkansas. In October, 1933, the location of the Sylamore Experimental Forest, consisting of 2,800 acres of typical Ozark oak and pine, was selected in the eastern division of the Ozark National Forest in north-central Arkansas. Development of the area was started in November under the supervision of Kuenzel, assisted by Cochran. On March 28, 1934, the Forester gave his formal approval of the permanent use of this area for research. By July the buildings and improvements were completed by H. M. Black, in charge of construction. They consist of a well-built five-room headquarters house, a smaller three-room camp house, a combined garage-office-tool house with considerable storage space, and a woodshed and storage shed for gasoline and oil. The sanitation and water systems constructed are temporarily adequate, but require further development. Two and one-quarter miles of telephone line were built, and a phone was installed. Approximately ten miles of fire lines have been cleaned along roads and boundaries, fire trails have been opened, and ten acres of cleared fields at the headquarters site have been fenced to exclude livestock. The entire experimental forest has been surveyed and mapped. National Forest roads bound the area on three sides and make it readily accessible. The National Forest officers, including the Civilian Conservation Corps at the nearby Camp Hedges, have cooperated helpfully in the establishment and improvement of the Sylamore Experimental Forest. E. R. Green, who lives about two miles from the headquarters, has been retained as resident caretaker in the absence of field crews from the Station.

During 1935, if funds are made available, it is planned to develop further the water, plumbing and sanitation systems at the headquarters. Roads will be improved and extended into the experimental area where needed. The present system of fire lines and trails will be developed to provide adequate protection against fire. The silvicultural development of the area is discussed under forest management investigations in the Research section of this report.

Illinois. Early in 1934 the tentative location of an Experimental Forest was selected within the recently established Shawnee National Forest purchase unit in southeastern Illinois. It lies along the drainages of Big Creek and Goose Creek, between Karber's Ridge and Elizabethtown. By July, approximately 1,000 acres of National Forest land had been acquired within the area selected, including a 40-acre tract suitable for a Branch Station administrative site. Development of this area was started in July under the supervision of Day, assisted by Sutton, with Earnest Bantel and William Wilson in charge of construction. By December, 1934, the improvements planned for this year were completed. They consist of an attractive 5-room headquarters house, a 3-car garage with facilities for storage of tools and equipment, a woodshed, a gasoline-oil shed, a water system consisting of a drilled well and pressure storage tank, a sanitation system, and the installation of telephone communication. Approximately 10 miles of fire lines have been cleaned. Improved gravel roads constructed through National Forest lands by C.C.C. Camp Hicks have made the Experimental Forest and the Branch Station headquarters readily accessible. About 2,500 acres of forest land within the area have been surveyed and mapped by Sutton and Piller.

If funds are made available in 1935, it is planned to add two more houses, an office and field laboratory building, and other minor improvements to the Branch Station unit, to provide for thorough utilization of the experimental forest by the Station staff in intensive studies of forest management and protection, reforestation, erosion control, and watershed investigations.

Indiana. Under a cooperative agreement with the Indiana Department of Conservation and the Purdue Agricultural Experiment Station, the 160-acre Hacker Creek experimental area on the Morgan-Monroe State Forest has been developed for the research use of the Station. A crew of ten C.W.A. employees, headed by Sutton, worked upon the area from December, 1933 to May, 1934, under the supervision of Day. Two and a half miles of boundary lines were surveyed, cleared as fire lines, and marked with permanent concrete corner posts; three miles of dirt roads and two miles of trails were improved; a headquarters site was cleared and graded; portions of the area were cleaned by the removal of old abandoned buildings, wire fences, and by the burning of brush and debris. The area was surveyed and topographic and type maps have been prepared by Sutton. At the present time a headquarters house and a garage for the use of the Station are being constructed under the direction of the State Forester.

Through the cooperation of Mr. Alexander Thomson, President of the Central States Forest Research Council, the Station has been invited to conduct research studies on his 1,300-acre estate, "Old Timbers," near Versailles, in southeastern Indiana. In the summer of 1934 Chapman spent several days observing the establishment and growth of nearly two hundred acres of forest plantations on this estate. Late in the fall he returned with Cochran, and together they made a thorough survey and inventory of the property. Large scale topographic and cover-type maps have been made for future use in plot location. The use of this area provides the Station with excellent opportunities for reforestation and management studies in both planted and natural stands on Clermont silt loam and "crawfish flat" soils, which are not found on any of the present State or National forest areas in this region.

Ohio. In December Diller supervised the survey of the Ohio experimental forest area of 125 acres on the Shawnee State Forest, which has been turned over to the Station for research use under a cooperative agreement with the Ohio Agricultural Experiment Station. A headquarters house and garage of log construction are now being built on the area under the direction of the State Forester. The use of this area provides the Station with an excellent opportunity for studying the establishment, growth and management of shortleaf pine near the northern extremity of its natural range in the Central States.

Cooperation in the use of private lands for research has enabled the Station to carry on work that would not otherwise have been possible, especially in investigations of farm woodland management, reforestation, and locust borer control. Of special value has been the Carnes area near Cambridge, Ohio, used by Hall in his locust borer work. This and other similar cooperative projects are described in the Research section of this report. As more National Forest areas are acquired in this region, it is hoped that the Station may secure additional experimental forests in Missouri, Ohio, and elsewhere. They are essential for the development of a permanent and well-balanced program of forest research.

Administration - Cooperation

During the past year the Station has necessarily participated in many phases of the greatly expanded conservation program of the region. While this has seriously reduced the time and effort that members of the staff could devote to their regular investigations, the importance of many of these new projects has fully justified the sacrifices made in order that the Station might cooperate helpfully with other agencies.

Unemployment Relief. A number of the development, administrative, and research projects, reported herein as the results of the Station's work in 1934, have been made possible by allotments of emergency funds for unemployment relief. Specifically, these represent Public Works (Nira) allotments for the construction of branch station improvements, for the development of experimental areas, and for forest research; Civil Works (C.W.A.) allotments for similar purposes; and Emergency Conservation Work (E.C.W.) funds for research contributing to the Civilian Conservation Corps (C.C.C.) program. From November, 1933 to December, 1934, inclusive, a period of fourteen months, these emergency projects have given employment to 175 persons for a total of 5,800 man-days, not including the permanent personnel of the Station paid from the regular appropriation. Sufficient unexpended E.C.W. research funds are at hand to carry eight members of the technical and clerical force until April, 1935, when it is hoped that additional emergency funds will be made available to continue and expand the Station's program of development and research.

Emergency Conservation Work. With the creation of the Civilian Conservation Corps in the spring of 1933, Leonard F. Kellogg of this Station was appointed E.C.W. Liaison Officer for the Fifth Corps Area, comprising the States of Ohio, Indiana, Kentucky, and West Virginia. He served on a part-time basis in this capacity until July, 1934, when he was relieved by the full-time appointment of W. E. Jackson, formerly State Forester of Kentucky. Since September, W. O. Stephens, in charge of C.C.C. inspection in Ohio and Indiana, has made his headquarters at the Station offices in Columbus.

Lumber Code. In January Baker was appointed as one of the public representatives to attend the Washington conservation conference, at which foresters and lumbermen reviewed the regional woods practice provisions of Article X of the Lumber Code. The Station cooperated with the public foresters and with the responsible representatives of the lumber industry in the North Central and Southern Hardwood Divisions, to secure satisfactory statements of compliance with the provisions of Article X. Baker and Day attended several Code meetings of public foresters and lumbermen at Lafayette, Indiana, at Memphis, Tennessee, and at Indianapolis, Indiana, later in the summer. Code problems were discussed with W. W. Fobes of the North Central Hardwood Division, and with E. R. Linn of the Appalachian and Southern Hardwood Divisions, in conferences at Columbus. Code authorities were furnished with pertinent data and information.

In the spring a survey was made by the Station under C.W.A. authorization, to determine for the Lumber Code Authority the kinds and amounts of wood consumed in Ohio and Indiana in producing and shipping various products. Competent investigators employed under Kellogg's and Parker's direction visited approximately one hundred wood-using industries in each State to secure this information. Later in the year, an attempt was made to determine the wood requirements of certain state, municipal, and public utility agencies in Columbus. Satisfactory data were secured only from the public utilities.

In December the Station participated in the initiation of a field demonstration of sustained yield management, in cooperation with the Regional Office of the Forest Service at Milwaukee, the Indiana Department of Conservation, and the Purdue Agricultural Experiment Station. This project, designed to demonstrate to forest owners and to timber operators the possibilities of sustained yield management and operation, will be developed during 1935. Day represents the Station in this enterprise.

Land Use Planning. The Missouri Land Use Conference, held in Columbia at the University of Missouri late in February, was attended by Baker, who spoke on the recent developments in conservation, and urged increased State participation. During the summer the Station cooperated with the Regional Office of the Forest Service, with Regional Director L. R. Schoenmann of the Land Policy Section of the A.A.A., and with the representatives of the several states in the comprehensive land use planning project of the region. Data from Station records and files were furnished to various agencies. Early in August, Kellogg attended the preliminary state meetings in Ohio, Day represented the Station at the Indiana and Illinois meetings, and Auten at the Missouri meeting. Baker attended the final state meetings in Ohio and Indiana, and the regional meeting in Chicago on August 31, where the final plans were discussed.

During 1934 the State Planning Board of Ohio, together with other agencies, developed interest in securing authorization for National Forests in this State, and called upon the Forest Service, through the Station, to furnish advice and information. Assistant Regional Forester A. C. Shaw visited Columbus twice during the year for this purpose. In November, the Ohio legislature passed an Enabling Act. A project for National Forest Acquisition was also started and developed in Indiana during the year.

Two articles on land utilization, written by members of the Station, have been published in 1934. An article by Day entitled "Forestry and Land Use in the Central States" appeared in Journal of Forestry, January, 1934. Reprints were secured. Baker's paper "Land Utilization in the Central States from the Standpoint of a Forester" read at the Chicago meeting in September, 1933, was published in the Proceedings of the Fourth Central States Forestry Congress.

Soil Erosion Service. Cooperation has been extended to the Soil Erosion Service of the Department of the Interior in the establishment of their demonstration of land use and erosion control in the Salt Creek drainage of the Muskingum watershed, east of Zanesville, Ohio. Auten and Baker attended several meetings in Zanesville to discuss plans and to review progress; various members of the Station staff have assisted with field inspections, advice and information; conferences have been held with the Vice-Director of the Soil Erosion Service, Dr. Walter Lowdermilk, with Chief Forester E. V. Jotter, with Regional Directors J. S. Cutler of Ohio and F. A. Fisher of Illinois, and with Forester J. A. Gibbs and members of his staff.

In June, Baker, Day and Kellogg inspected the experimental pasturage-erosion control project in southern Illinois with Dr. E. A. Norton of the University of Illinois and Regional Director F. A. Fisher of the Illinois Soil Erosion Service. Close contacts will be maintained between this project and the Station's work on the Illinois Experimental Forest, since similar problems occur on both areas.

Meetings. In addition to the conferences and meetings already mentioned in this report, members of the Station attended the Fifth Central States Forestry Congress at Knoxville, Tennessee; the annual meeting of the North Central States Entomologists at Lafayette, Indiana; the Central States Section of the Society of American Foresters at Harrisburg, Illinois; the Ohio Forestry Association and the Ohio Academy of Science at Columbus, Ohio; the American Soil Survey Association at Washington, D. C.; and the joint meeting of the Society of American Foresters and the Ecological Society at the Pittsburg meeting of the A.A.A.S. Members of the Station serve as officers and on committees of many of these and other organizations. Talks have been given at several of these meetings, to various groups of faculty and students at Missouri, Purdue and Ohio State Universities, and to C.C.C. superintendents and foremen at Chillicothe, Ohio.

Research Council. The terms of the following members of the Central States Forest Research Council expired in 1934: Stanley Coulter, C. A. Dyer, W. F. Lodge, Paul C. Stark, and William Trelease. To fill these vacancies, the following new appointments have been made by the Secretary of Agriculture: T. H. Frison, chief of the Illinois Natural History Survey; Chas. A. Gillett, State Forester of Arkansas; S. B. Locke, Conservation Director of the Izaak Walton League of America; Lachlan Macleay, Executive Vice-president of the Mississippi Valley Association; and A. F. Moon, President of the Ohio Conservation Council. A complete list of the 1935 Council personnel will be found on page 4. No formal meeting has been held during 1934, because of the unsettled conditions affecting the Station's work, but frequent contacts with members have been maintained by personal visits when possible, and by means of letters and reports.

Station Organization. Under the emergency conditions of the past year the Station organization has functioned exceptionally well, and all members deserve commendation for the manner in which they have accepted increased responsibilities in addition to their regular work. No changes have been made in the regular personnel of the Station during 1934. Ralph K. Day was promoted to the position of Associate Silviculturist on September 1, and John Kuenzel's promotion to Assistant Silviculturist becomes effective in January, 1935. These promotions were made possible by increased responsibilities in connection with forest management investigations. The list of personnel of the Station staff on page 3 indicates expansion due to emergency work in 1934. Parker has installed many new features of office procedure which have added greatly to Station efficiency. Increased enrollment of students at Ohio State University and the consequent demand for space forces the Station to accommodate itself to crowded quarters with insufficient laboratory and storage facilities.

RESEARCH INVESTIGATIONS

FOREST MANAGEMENT

Ralph K. Day, In Charge
John G. Kuenzel
Oliver D. Diller
Claud E. Sutton

Farm Woods (M-2)

Management of Farm Woods. Progress in management research has been held up considerably during 1934 by demands upon Day's and Kuenzel's time for supervision of branch station developments. In July, Diller and Marshall made an intensive study of a severely cut oak-hickory stand near Logansport, Indiana, which will be followed by periodic remeasurements of growth and regeneration. A project was also started to determine the percentage of cruise necessary to provide an accurate timber estimate under the variable conditions usually found in farm woods. The field work of the cooperative demonstration of sustained yield management, previously mentioned as a Lumber Code project, has begun and will be continued in 1935.

Diller collected data in 1933 on the effects of drouth on the growth of beech in Indiana. A comparison of growth with weather records indicates a closer correlation between growth and temperature than between growth and rainfall. High temperatures during the month of June apparently have the greatest effect in slowing down growth by causing excessive transpiration. Diller's article has been submitted to Ecology for publication. It will appear in the January, 1935 issue.

Woodland Grazing. In cooperation with Purdue Agricultural Experiment Station, the woodland grazing and carrying capacity study at the Pinney-Purdue Farm has been continued for the fourth year. Livestock held in the overgrazed and depleted woodland pastures were given supplemental feeding necessary to maintain weights. Comparison of costs of this practice with costs of maintaining livestock in good open pastures is expected to indicate the lack of actual forage value in wooded pastures.

The results of this project for the first three years have been summarized in a joint publication by DenUyl and Day, issued as Bulletin 391 of the Purdue Agricultural Experiment Station: Woodland Carrying Capacities and Grazing Injury Studies. An article by Day on pasturing farm woods appeared in the U. S. Department of Agriculture Yearbook for 1934. To give emphasis to measures of land use advocated by governmental agencies, which may react favorably in the maintenance of farm woodlands, Day prepared Station Note No. 12: Reduce Woodland Grazing by Increasing Pastures. A similar short article by Diller, dealing with the influence of crop reduction measures to the farm woods, appeared in the Indiana Farmers Guide of June 9, 1934.

Regeneration After Grazing. Data so far obtained from annual measurements of reproduction in farm woods following the removal of livestock have been thoroughly analyzed. The 1934 remeasurement of approximately forty regeneration plots was begun early in June and completed in July by Diller and Marshall. The volume of work this year was considerably reduced by eliminating the annual remeasurement of plots where the establishment and growth of reproduction had become relatively stable.

Diller's study of the environmental factors influencing the growth and survival of seedlings has shown soil moisture content to be lower in grazed woods than in ungrazed woods or in open fields. Whereas loss of water through transpiration is high in ungrazed woods, there is relatively little loss from soil evaporation. In open fields there is little transpiration loss, but evaporation is high. In open wooded pastures, however, both transpiration and evaporation losses are high. This appears to be a very important factor in preventing the successful regeneration of overgrazed woodlands. Diller used data of this study for the dissertation required in securing his doctorate in forest ecology from Ohio State University in March, 1934.

Upland Forest (M-3)

Type Maps and Timber Estimates. Preliminary to the initiation of intensive management investigations in upland oak types, all of the experimental areas acquired by the Station have been surveyed and mapped in 1934. Type maps have been completed for the Indiana and Arkansas areas and are being prepared for the others. The field data of a timber estimate of the Sylamore Experimental Forest have been secured by Kuenzel, who is now preparing the report of this area.

Oak-Pine Management. In June, E. G. Wiesehuegel, professor of forestry at Ohio State University, accepted a three-months' appointment to start forest management work on the Sylamore tract in Arkansas. With the help of Cochran and Van Sickle and a crew of several local men, thirty permanent plots were established during the summer. Most of these were growth plots located in typical stands of various ages and composition of species, scattered over the area. Two series of four plots each were established in connection with the timber stand improvement work of the Ozark National Forest. With the exhaustion of funds for this project, the work was terminated on September 15.

Chestnut Oak Regeneration. In November, Kuenzel completed the annual remeasurements of the chestnut oak regeneration plots in Ohio and Indiana. Auten cooperated with soil tests of the Ohio quadrats. A high correlation was found to exist between seedling survival and litter depth, as might be expected when the beneficial effects of litter are considered. The contrast in reproduction on areas of moist, porous soil protected by a good leaf cover, and on dry, compacted soil unprotected by litter, was

apparent within a distance of a few feet. Under the dense shade of the control plots the chestnut oak reproduction has persisted but little growth has been made. In the clear-cut plot good growth suggested a study of comparative growth of sprout and seedling reproduction, which will be carried on by periodic remeasurements.

Selection Cutting. Kuenzel and Cochran completed the five-year remeasurements of the Mill Tract plots on the Clark County State Forest near Henryville, Indiana, which had been given a selection cutting in 1929. Tables showing the increase in growth by species for each forest type have been prepared. Increment borings were made in all crown classes for each species to determine the rate of growth before and after cutting. The data will be analyzed and compiled as opportunity offers.

Plans for 1935. Remeasurements will be made of the regeneration plots of the farm woodland management study, including the first five-year remeasurement of the growth of the larger trees in grazed and ungrazed stands. The Station's cooperation in the sustained yield demonstration in Indiana will require collection of growth data and a certain amount of technical supervision of other work. Two Station automobiles have been temporarily loaned to field crews now at work. Sutton, who has remained at the Illinois Branch Station during the winter, will continue the establishment of growth and management plots on the experimental area. Data, records and reports of past work will be brought up to date.

If funds for additional work are secured, management studies will be greatly expanded, in the upland forest types found on the experimental areas of the Station, and in the farm woods of the Corn Belt. More permanent growth plots will be established, and studies of cutting methods will be started. The methods and results of stand improvement work now being undertaken by many C.C.C. camps will be observed, and followed up with permanent plots. An effort will be made to cover certain phases of fire problems in the management projects of the Station.

FOREST PLANTING

Leonard F. Kellogg, In Charge
Arthur G. Chapman

Plantation Survey. A survey of all known forest plantations in the southern, unglaciated portions of the Central States was completed by Chapman in 1934. The purpose of this survey was to appraise and evaluate past and present planting practices, to bring to light the outstanding planting problems of the region, and to determine those species which hold the greatest promise for successful use in a greatly expanded reforestation program.

The reconnaissance extended over the western parts of Kentucky and Tennessee, the northern half of Arkansas, and the southern portions of Missouri, Illinois, Indiana, and Ohio. Contacts were made with public nurseries and with all agencies engaged in forest planting. Observations were

made of natural regeneration, the composition of forest types, and the susceptibility of various species to damage by drought, as a guide to the choice of species for future planting. A wealth of data was secured, on the compilation of which Chapman is now working.

The survey has been of great value in presenting a comprehensive and detailed picture of the whole planting problem. Assistant Regional Forester H. B. Wales, visited the Station in October to discuss those phases which pertain to the reforestation of National Forest lands in this region. One problem of immediate importance concerns the present practice of planting conifers in mixture with black locust. To warn planters of the doubtful success of the conifers when mixed with locust, Kellogg prepared Station Note No. 15: Failure of Black Locust-Coniferous Mixtures in the Central States, which was distributed in October.

Black Locust Growth and Yield. The construction of volume tables for plantation black locust was started in December, 1933, and carried on through the winter with C.W.A. and E.C.W. personnel working under Kellogg's supervision. Four volume tables giving contents in cubic feet and board feet were completed in April. A set of taper tables was then prepared from the 400 stem measurements available, and from these taper tables two more volume tables, giving contents in posts and bolts, were derived. The six volume tables were mimeographed and distributed as Station Notes Nos. 7-9-10-11-13 and 14, listed on the last page of this report.

When the volume tables were being made, the preparation of tabulation sheets for black locust yield plots was also in progress. As each table was completed the new values were entered and the necessary calculations were made. In August the 254 plot sheets were sent to Washington, where the data were entered on cards, runs were made, and the totals were returned to the Station. A portion of the plots are in mixed stands (both planted mixtures and pure stands with volunteer growth), but more than 200 plots classify as pure stands. As opportunity offered, Myer has compiled and classified the descriptive data dealing with black locust planting. He has also done this for the black walnut records.

Black Walnut Growth and Yield. Unavoidable postponement of the completion and publication of the report on growth and yield of plantation black walnut has made it advisable to distribute the volume tables for general use without further delay. Accordingly a set of five tables, giving contents in cubic and board feet, were mimeographed in December as Station Notes Nos. 17-21, inclusive. They are listed on the last page of this report.

Miscellaneous. Several inquiries about tree seed, its size and weight, have emphasized the lack of data on many of the species of this region. Kellogg and Myer, with the aid of other members of the staff, have initiated the collection of this information. Measurements of seed of several species have already been made.

Additional stem measurements of white pine, catalpa, red and Corsican pine, secured from various sources have been plotted on Form 558-a, checked, and planimetered. Most of this was done by C.W.A. employees early in the year.

In cooperation with Hall, Kellogg and Myer made an experimental underplanting of white oak acorns in plots of black locust on the Carnes area in Guernsey County, Ohio. In some of these plots hardwood litter had been introduced, while others had a ground cover only of weeds and locust litter. The continued drought through the autumn months may have prevented the establishment of the oak.

An illustrated article by Kellogg, descriptive of the methods used in securing stem measurements of standing trees in black locust and black walnut plantations, appeared in the October, 1934 Journal of Forestry. It is entitled: The Climbing Method for Taking Tree Measurements in Plantations in the Central States. Reprints were secured.

Plans for 1935. A special effort will be made in 1935 to complete for publication the report on plantation black walnut, after which Kellogg will carry forward as far as possible the similar study of black locust. Chapman will prepare the report of his 1934 survey of forest planting, and it is probable that information concerning certain important phases of this investigation will be made immediately available through Station Notes. Plans for the cooperative production of nursery stock for experimental planting, and studies of nursery practice, are now being prepared with the Floriculture Department of Ohio State University. Similar cooperation may be secured with other agencies. A limited amount of experimental planting will be started on the Station's research areas in Illinois and Arkansas, with black locust, shortleaf and pitch pines. The collection and measurement of native tree seeds will be continued. Permanent plantation plots will be remeasured as opportunity offers.

If additional funds are secured, preparation for an expansion of experimental planting will be made by increased seed collection, development of nursery facilities, and studies of planting sites and methods. More information should be secured regarding the establishment and growth of plantations now found throughout the region. Additional stem measurements of planted trees, both of exotic and native species, are needed. Remeasurement of yield plots of black walnut and black locust, to determine the actual rate of growth since the plots were laid out, will be made if funds become available.

FOREST SOILS

John T. Auten, In charge

Water Absorption. During 1934 Auten extended his original study of porosity and water absorption of forest soil (1) by making some 4,000 additional tests in the Ozark region, in cherty and sandy soils of northern Arkansas, and in silt loam soils of southern Illinois. In each instance the rate of water absorption was recorded in undisturbed woods, in burned woods, and in open pastured fields. The results of this study have been mimeographed as Station Note No. 16: The Effect of Forest Burning and Pasturing in the Ozarks on the Water Absorption of Forest Soils. Convincing data are given on the effectiveness with which undisturbed forest cover influences water absorption and retards run-off. On silt loam and clay soils of fine texture this influence is very great, and even on the stony and sandy soils it is most significant. Where the forest has been repeatedly burned and the protective ground cover of litter destroyed, or on cleared lands pastured by livestock, there was a very great decrease in the rate of water absorption. The results of this study emphasize the need for forest protection and for reforestation of cleared, non-agricultural lands, as important measures of run-off control.

Plantation Sites. The project, involving an examination of soil profiles of 120 black walnut and 135 black locust plantations in 1932 and 1933, culminated in a final report which was submitted to the Washington office for review in June. The outstanding feature of this study of site requirements was the obvious relationship of the texture and structure of the subsoil to the growth of both walnut and locust. Fertility of the surface soil, although important, is apparently of less significance than those conditions of subsoil which effect the amount, movement, and distribution of soil water. A summary of the site requirements of black locust was mimeographed as Station Note No. 4 in 1933.

Base Exchange. This study, completed in 1933, deals with the relation of calcium and magnesium losses to soil changes in the transition from forest to field conditions, and the effect of changed site conditions upon tree growth. Auten's article: "Calcium and Magnesium Losses from the Cultivation of Forest Land" appeared in print in the April, 1934 issue of the Journal of Forestry.

Bibliography of Organic and Forest Soils. As chairman of the Organic and Forest Soil Committee of the American Soil Survey Association, Auten, with the cooperation of the committee members, compiled a bibliography containing references to forest soil literature from 1926 to 1934. This supplements an earlier bibliography. With the approval of the committee and officers of the Association, a limited number of copies were mimeographed and distributed by the Station. The Branch of Research of the Forest Service is now mimeographing an additional supply, with addenda, which will be available for general distribution.

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(1) Reported in the Journal of Agricultural Research, Vol. 46, No. 11, and summarized as a mimeographed Station Note No. 8.

Soil Surveys. During the past summer Auten made a general soil survey and map of the Sylamore Experimental Forest in Arkansas, and collected soil samples for analysis from the growth and management plots established on this area. He also cooperated with Hall in a soil survey of the Carnes experimental area in Ohio. Since knowledge of site conditions is essential to any study of tree growth, it is planned to extend soil surveys as rapidly as possible to all experimental areas, and to make soil and site inventories of all permanent plots.

Plans for 1935. In 1935 it is planned to continue the site requirement study of planted tree species which already has been started for black locust and black walnut. Outstanding plantations of various species located by Chapman during his reconnaissance survey of 1934 will serve as the basis for this study. Special attention will be directed toward the physical properties of the plantation sites exhibited in the soil profile. At the same time water absorption tests will be made in plantations and in adjacent areas of bare land, to obtain more data on this phase of forest influence in water conservation and run-off control. If additional emergency funds are made available, the forest influence studies of the Station will be expanded to include other erosion control and watershed investigations urgently needed in this region.

FOREST INSECT INVESTIGATIONS

Bureau of Entomology and Plant Quarantine

Ralph C. Hall, In charge

The locust borer study continues to be the most important forest insect investigation in this region, and during the past several years has received major consideration. This problem is unquestionably being increased by the widespread use of black locust for erosion control planting. Several other insects have come to attention during the past year, some of which threaten to become of major importance. Among these are the pine tip moth, acorn insects, the locust twig borer, and the white grub.

Locust Borer. The study of the locust borer has indicated that the amount of injury is very closely correlated with the rate of tree growth. The past season's work has materially strengthened this conclusion, although only part of the data has been fully analyzed. During 1934, studies of the locust borer problem have involved the following phases: an ecological study of tree growth under different conditions of site correlated with the life history of the borer and the factors responsible for larvae mortality; stem analysis studies to determine the correlation between emergence of adult borers and early growth rate of the tree; studies of acceleration of growth rate of black locust by thinning, by coppicing, and through site improvement by mulching; studies of improved and apparently borer resistant varieties of black locust, in cooperation with the Bureau of Plant Industry; studies of the effect of drought on locust borer attack and survival; and remeasurement of established study plots.

Cooperation. In the Central States there are few areas suitable for locust borer experimentation now under public ownership. Therefore, it has been necessary to secure the cooperation of private land owners for the establishment of study plots. Cooperative investigations have been conducted on the following properties: the 53-acre tract of S. C. Carnes, Cambridge, Ohio, containing 40 acres of planted and natural locust growth from 1 to 22 years of age; 80 acres of locust from 6 to 8 years old planted by the Metropolitan Brick Company of Minerva, Ohio; numerous locust plantings from 8 to 13 years of age on spoil banks of the Wayne Coal Company near Hopedale, Ohio; an 80-acre tract owned by A. F. Gustafson at Bath, Illinois, containing about 20 acres of locust up to 17 years of age; about 3 acres of locust sprouts 2 years of age owned by T. S. Chapman, Jerseyville, Illinois; 10 acres of planted locust from 3 to 5 years old, owned by J. L. Barton, Rushville, Illinois; 20 acres of black locust ranging from 1 to 22 years of age on the property of A. C. Hart, Arenzville, Illinois; and the locust and pine plantations of the Illinois Agricultural Experiment Station at Elizabethtown, Illinois. Mr. L. E. Sawyer, Extension Forester of Illinois, has been especially helpful in promoting cooperation in his State.

Locust Twig Borer. The effect of the locust twig borer on rate of growth of seedlings and sprouts has been studied in connection with life history studies on the locust borer. The results indicate that considerable reduction in height growth is brought about by the attack of the twig borer.

Pine Tip Moth. The pine tip moth is becoming a very important forest insect in the Central States. Several instances of serious injury to pines have been noticed by Hall in Kentucky, Tennessee and Illinois. During Chapman's study of plantations in this region last season, he noted that numerous plantations of shortleaf and loblolly pine were seriously injured by this pest. Lack of adequate finances has prevented a thorough study of this insect, but an attempt at control was made in one badly infested plantation in southeastern Illinois. All the infested tips were removed during the winter, but it will be necessary to await the spring emergence of moths before the effectiveness of these measures can be determined.

Acorn Insects. The U. S. Forest Service, the Soil Erosion Service, State Forestry organizations, and other agencies in this region collected large quantities of acorns for field planting last fall. Numerous reports were received concerning the damage of these acorns by insects, some collections being so badly infested that it seemed not worth while to plant them. As a result of requests, various methods of controlling these insects were tested. The effectiveness of control measures, however, will not be apparent until germination and field planting tests are completed.

White Grubs. The white grub has recently been recognized as a very serious menace to young conifer plantations in the northern part of the Lake States. From several observations here in Ohio, it would appear that this insect may become a serious pest in young plantations. Two instances were noted where the grubs had killed about 50 per cent of red pine plantations in less than three months after field planting. No work other than observation was possible last season, due to lack of funds.

Plans for 1935. If funds are available the program for 1935 will include the following projects, listed in the order of their importance: Remeasurements will be made of established locust borer study plots. The ecological studies of black locust growth in relation to borer survival, and studies of management of black locust stands for borer control, will be continued. The relation of twig borer injury to black locust growth and borer control should be studied. It is also hoped that funds and personnel may be made available for carrying on investigations of the life history, damage and control of the pine tip moth, the white grub, and acorn insects.

Station Publications - 1934

Forestry and Land Use in the Central States. By R. K. Day
Journal of Forestry, Vol. XXXII, No. 1, January, 1934. Reprints.

Calcium and Magnesium Losses from the Cultivation of Forest Land. By J. T. Auten
Journal of Forestry, Vol. XXXII, No. 4, April, 1934.

Climbing Methods for Taking Tree Measurements in Plantations in the Central States. By L. F. Kellogg. Journal of Forestry, Vol. XXXII, No. 7, October, 1934. Reprints.

Land Utilization in the Central States From the Standpoint of a Forester. By W. M. Baker. Proceedings of the Fourth Central States Forestry Congress, Chicago, Ill., Sept., 1933.

Woodland Carrying Capacities and Grazing Injury Studies. By Daniel DenUyl and R. K. Day. A cooperative publication issued as Bulletin 391 of the Purdue Agricultural Experiment Station, March, 1934.

Crop Reduction and the Farmwoods. By O. D. Diller. Article published in the Indiana Farmers Guide, June 9, 1934.

Farmwoods Afford Poor Forage and Deteriorate Rapidly when Overgrazed. By R. K. Day. Article in U.S.D.A. Yearbook, 1934. Page 205.

Annual Investigative Report for 1933 and Program for 1934. By the Station Director and Staff.

Also the following mimeographed Station Notes:

7. Black Locust Volume Table - Total Cubic Feet. L. F. Kellogg
8. Porosity and Water Absorption of Forest Soils. J. T. Auten
9. Black Locust Volume Table - Board Feet by International Rule. L. F. Kellogg
10. Black Locust Volume Table - Board Feet by Scribner Rule. L. F. Kellogg

11. Black Locust Volume Table - Merchantable Cubic Feet. L. F. Kellogg.

12. Reduce Woodland Grazing by Increasing Pastures. R. K. Day

13. Black Locust Volume Table - fence posts. L. F. Kellogg

14. Black Locust Volume Table - bolts. L. F. Kellogg

15. Failure of Black Locust-Coniferous Mixtures in the Central States. L. F. Kellogg

16. Effect of Forest Burning and Pasturing in the Ozarks on the Water Absorption of Forest Soils. J. T. Auten

17. Black Walnut Volume Table - Total Cubic Feet. B. R. Lexon.

18. Black Walnut Volume Table - Merchantable Cubic Feet. B. R. Lexon

19. Black Walnut Volume Table - Board Feet by International Rule - 5" top. B. R. Lexon and V. A. Clements.

20. Black Walnut Volume Table - Board Feet by Scribner Rule - 8" top. L. F. Kellogg

21. Black Walnut Volume Table - Board Feet by Scribner Rule - 10" top. L. F. Kellogg

In Press

The Effects of Black Locust on Associated Species with Special Reference to Forest Trees. By A. G. Chapman. Article in collaboration with the Botany Department of Ohio State University. Ecological Monographs, January, 1935.

Relation of Temperature and Precipitation to Growth of Beech in Northern Indiana. By Oliver D. Diller. Article in collaboration with the Botany Department of Ohio State University. Ecology. January, 1935.